Space Weather Technical Forecast

Issued on Sunday, 19 June 2022 at 01:12 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Daily Chance of an isolated M-class flare. Chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low through the UTC day of Saturday 18 June, with background X-ray flux recorded at GOES16 steady on the boundary between B and C class. Occasional small X-ray flares were generally well-spread between many of the front-side sunspots, of which there were nine numbered regions and up to three unnumbered. The largest flare of the period was a C4.9 at 18/2105UTC from AR3031, which ended the 24 hours as a Eao/Beta, having shown a reduction in area and shrinking trailing spots in the period.

Most of the current roster of sunspots are small and simple, with three Axx groups, two Hsx and three Bxo. Of the remainder, the most noteworthy were AR3030 in the northwestern quadrant, which manifested as a Dai/Beta; and AR3038 in the northeast, which finished as a Cai/Beta. AR3030 showed a spreading and amalgamating trend in its trailing group, while AR3038 showed proliferation of its intermediate spots, although neither produced particularly marked flare activity as a result.

A large filament in the northwestern quadrant showed some movement into the early evening UTC, as did a smaller feature in the northeast to end the 24 hours, however at the time of writing neither appeared to result in any ejecta. There was no evidence of any Coronal Mass Ejections (CMEs) on available coronagraph imagery, and there are thought to be none en route at present.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, was relatively static in the past 24 hours and is presumed to remain characteristic of a continuing fast wind, most likely from CH90/+ or perhaps CH92/+.

The solar wind speed showed a very slight decline in the 24 hours through 600km/s, while the solar wind density was near-flat about 10ppcc. The IMF was within normal background levels with a peak of 7nT and a north-south variation of +/-5nT. Finally, the phi angle remained positive (away from the sun).

The net result of the above solar wind measures was erratic, with a provisional peak of Kp 5- (i.e. G1) in the 21-24UTC interval.

Energetic Particles / Solar Radiation: Electron flux (greater than 2MeV) was at Moderate to High levels in the period, in an augmented oscillation compared with the previous UTC day, with a peak of 1380pfu observed at GOES16 at 18/1615UTC. Corresponding 24-hour integrated electron fluence showed a rising trend, with a value of 4.95e7 integrated pfu observed at 19/0001UTC.

The high energy proton flux (10 MeV) measured by GOES16 finally fully relaxed to Background

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levels in the period, having been very slightly enhanced at 10MeV since the 13 June M3 flare.

Four-Day Space Weather Forecast Summary

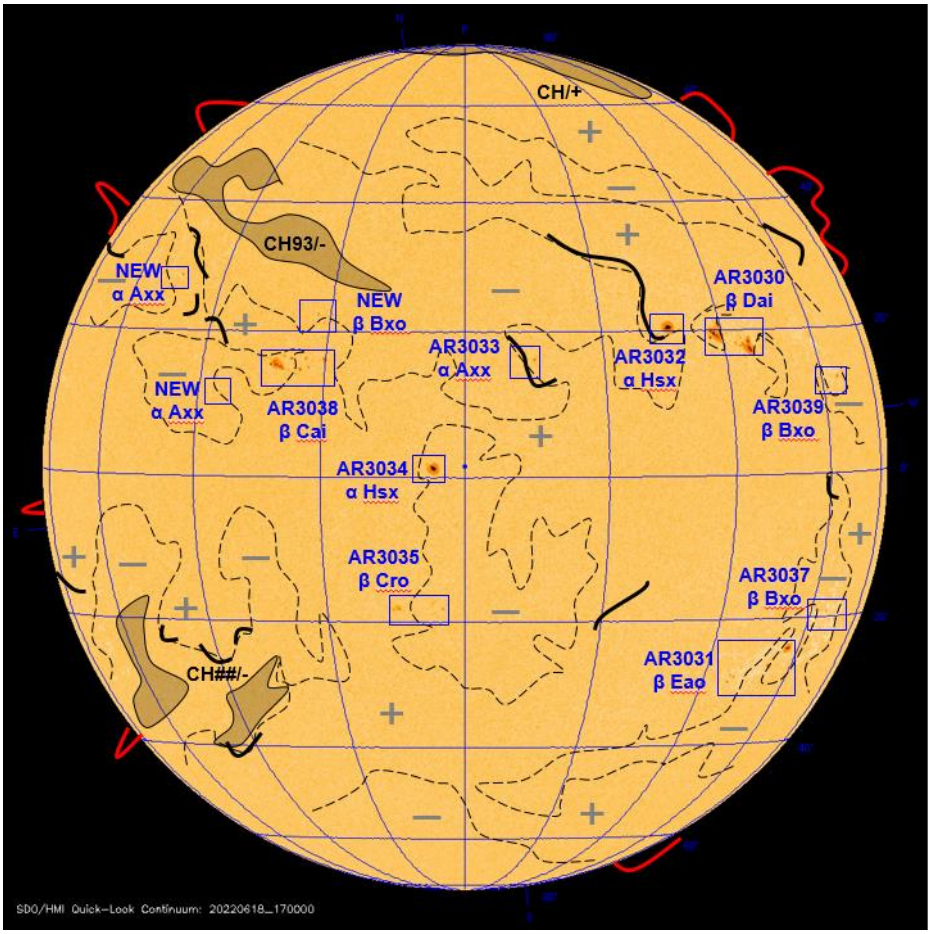
Solar Activity: Solar activity is likely to be Low, with a daily Chance of an isolated M-class flare.

Solar Wind / Geomagnetic Activity: No CMEs feature in the forecast, and the only fast wind is that being experienced at present. Geomagnetic activity should therefore peak on day one, Sunday 19 June, with a Slight Chance of an isolated G1 interval, else gradually decreasing to mainly Quiet into the new working week, with a slow regime probable from Tuesday (day three).

Energetic Particles / Solar Radiation: High energy electron flux (greater than 2 MeV) may show further slight day-on-day increases in response to the current fast wind, probably becoming marginal for 24-hour integrated Active fluence early in the four days, but perhaps most likely falling just short given the now slowing rate of increase.

High energy proton flux (greater than 10 MeV) is expected to be at Background levels during the period, but with a daily Slight Chance of an S1 or greater event occurring, mainly due to the presence of AR3030 and AR3031 as nominally complex regions nearing the western limb.

Figure 1. Solar Analysis Valid 18/1700UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the forecast, and the sole coronal hole influence is the already mature feature currently affecting Earth. This is probably the fast wind emanating from CH90/+ or perhaps CH92/+, although the onset(s) were likely clouded by the 13 June CME's arrival.

No further coronal hole high speed streams are due, and current STEREO A MAG and PLASTIC data, while patchy, does not suggest a continuing high speed stream as of around two days' time. Quiet conditions and a slow solar wind regime therefore ought to be re-instated at Earth by Tuesday 22 June, with a Slight Chance of isolated G1 intervals on Sunday 20 June (day one) at peak, and with Wednesday the most reliably Quiet day.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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Radio Blackouts - X-Ray Flares:

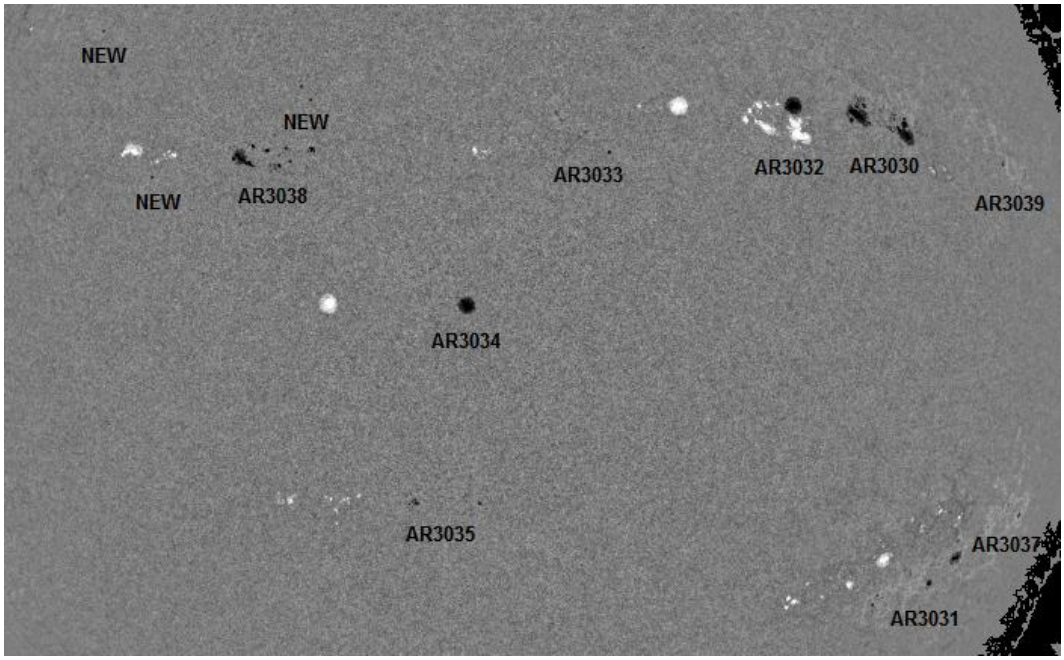
There are currently up to twelve sunspot regions on the solar disc, although they are well-spread and the vast majority are either unipolar or simple dipoles. The sheer number of groups as well as the three or four more complex entities make for relatively high raw probabilities of X-ray flares, however this is still not being borne out, and the background X-ray trace recorded at GOES16 remains very flat.

STEREO A EUVI195 imagery suggests there is a degree of survival of plage or sunspots in the (up to four) returning regions due in the period. These may go some way to compensating for the loss of AR3031 midweek, however this is conjectural until they present for analysis over the eastern limb.

All considered, there is a daily Chance of M-class flares (reduced relative to raw values), further dipping midweek as the largest and most active sunspot AR3031 departs for the far side.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	20
Very Active	R3 to R5 X Class	No	5	5	5	1

Figure 3: 24-hour 1-day running difference HMI Continuum imagery from 17/2300UTC and 18/2300UTC. Spots as they appeared on 17 June are white, and current observations are black. Labels appear beneath each active region for 18 June only. Image processing courtesy of Helioviewer.org.



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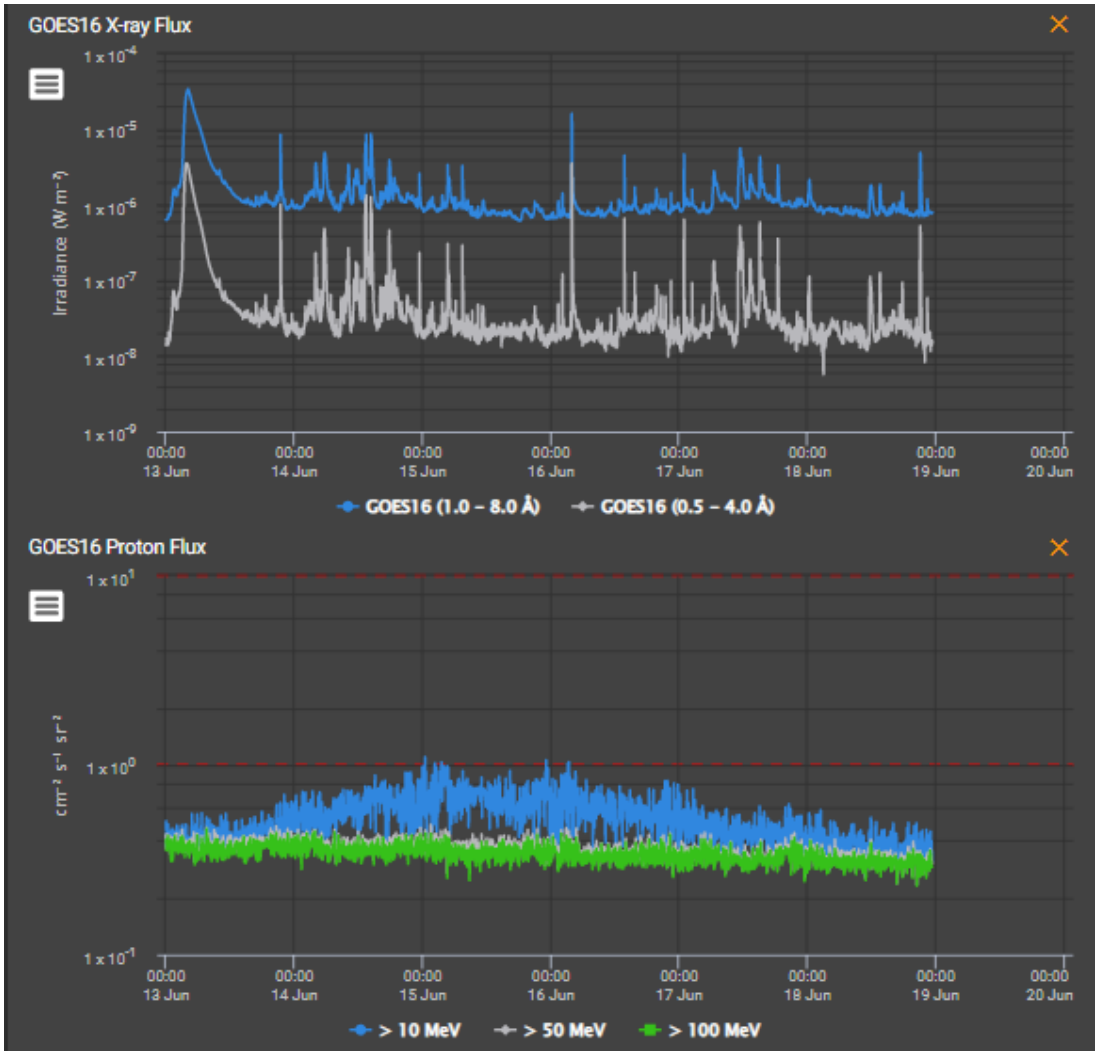
Solar Radiation Storms - (High Energy Protons):

There is a daily Slight Chance of an S1 or greater event in the period, although given the well-spread nature of the larger regions on the disc, this averages around a daily 5% risk as any departing regions should be reinforced by the westward transit of the remaining spots.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Top: GOES16 X-ray flux, showing 13 June M3 flare and resultant (below) GOES16 high energy proton flux, with the 10MeV showing a delayed and damped slight enhancement.



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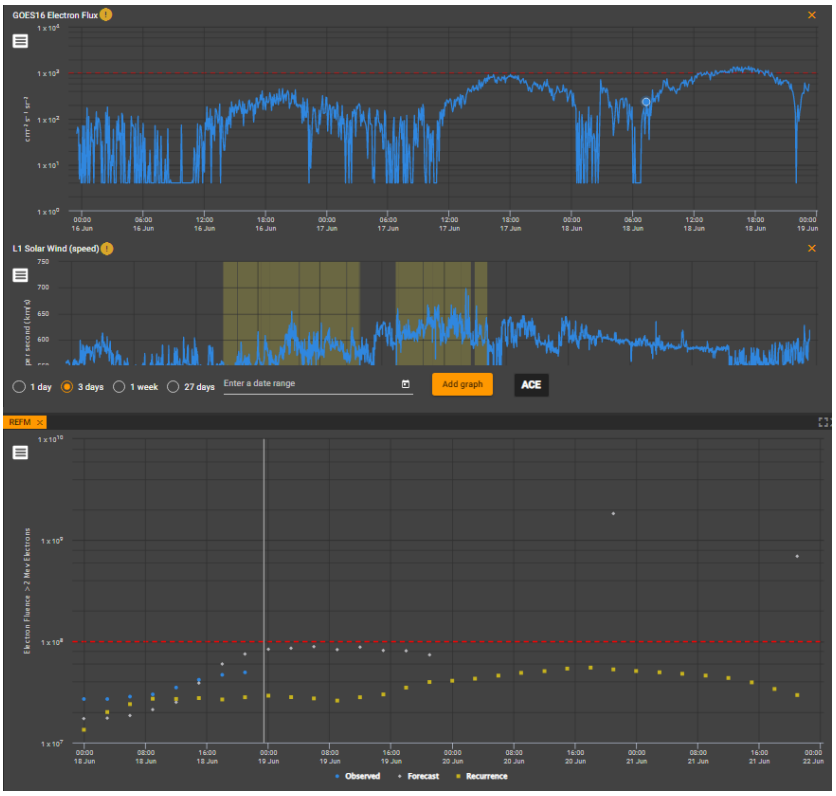
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16 has shown an increase in the magnitude of its diurnal oscillation in response to the current fast wind near 600km/s. This has led to a rise in 24-hour integrated fluence, however this trend has recently slowed. Increased geomagnetic activity late in the past 24-hour period may further dent counts at GEO for a time, however it is still felt that any recovery ought to fall just short of Active fluence levels, as per previous rotation.

MOSWOC REFM is currently felt to be offering good guidance inside the first 24 hours, however the forecast beyond this is considered overly-reactive to the fast wind and will probably be a full decade lower near the Active rather than Very Active threshold.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	30	40	40	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: Top: GOES16 high energy electron flux since 13 June, showing rising diurnal oscillation since the onset of the current high speed stream (L1 speed shown middle). Also shown is the resultant 24-hour integrated electron fluence observations, persistence and REFM. Note that REFM's thoughts beyond 24 hours are considered significantly overdone.



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